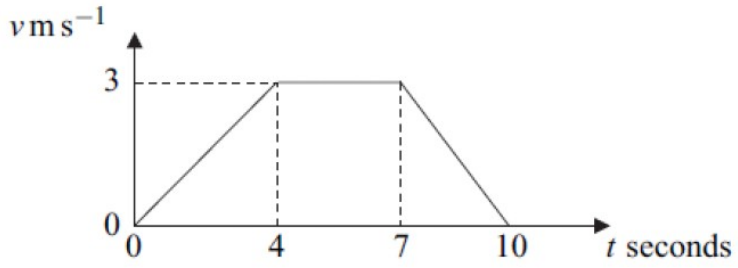
Old Spec Exam Questions

June 2008

1 The diagram shows a velocity–time graph for a lift.

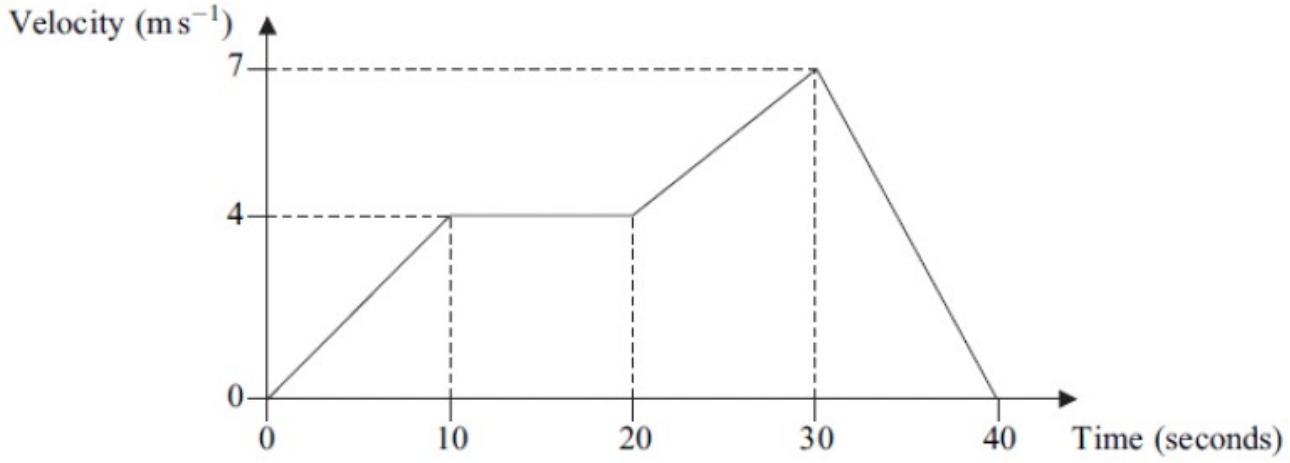


(a) Find the distance travelled by the lift. *(3 marks)*

(b) Find the acceleration of the lift during the first 4 seconds of the motion. *(1 mark)*

January 2011

2 The graph shows how the velocity of a train varies as it moves along a straight railway line.



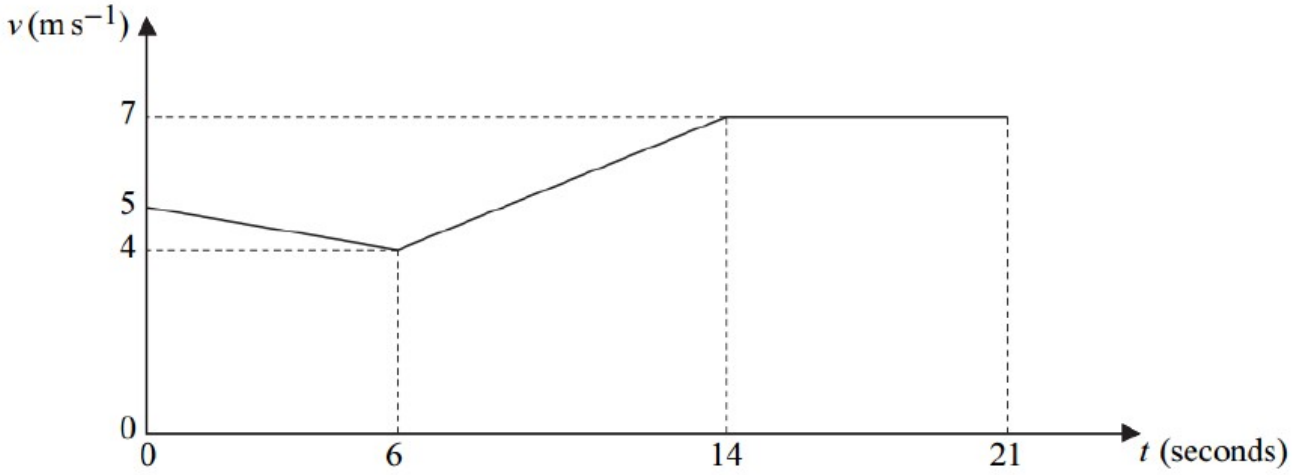
(a) Find the total distance travelled by the train. *(4 marks)*

(b) Find the average speed of the train. *(2 marks)*

(c) Find the acceleration of the train during the first 10 seconds of its motion. *(2 marks)*

June 2013

2 The graph shows how the speed of a cyclist, Hannah, varies as she travels for 21 seconds along a straight horizontal road.



(a) Find the distance travelled by Hannah in the 21 seconds. *(4 marks)*

(b) Find Hannah's average speed during the 21 seconds. *(2 marks)*

January 2006

6 A van moves from rest on a straight horizontal road.

(a) In a simple model, the first 30 seconds of the motion are represented by three separate stages, each lasting 10 seconds and each with a constant acceleration.

During the first stage, the van accelerates from rest to a velocity of $4\,\text{m s}^{-1}$.

During the second stage, the van accelerates from $4\,\text{m s}^{-1}$ to $12\,\text{m s}^{-1}$.

During the third stage, the van accelerates from $12\,\text{m s}^{-1}$ to $16\,\text{m s}^{-1}$.

(i) Sketch a velocity–time graph to represent the motion of the van during the first 30 seconds of its motion. *(3 marks)*

(ii) Find the total distance that the van travels during the 30 seconds. *(4 marks)*

(iii) Find the average speed of the van during the 30 seconds. *(2 marks)*

(iv) Find the greatest acceleration of the van during the 30 seconds. *(2 marks)*

January 2007

2 A lift rises vertically from rest with a constant acceleration.

After 4 seconds, it is moving upwards with a velocity of $2\,\mathrm{m\,s^{-1}}$.

It then moves with a constant velocity for 5 seconds.

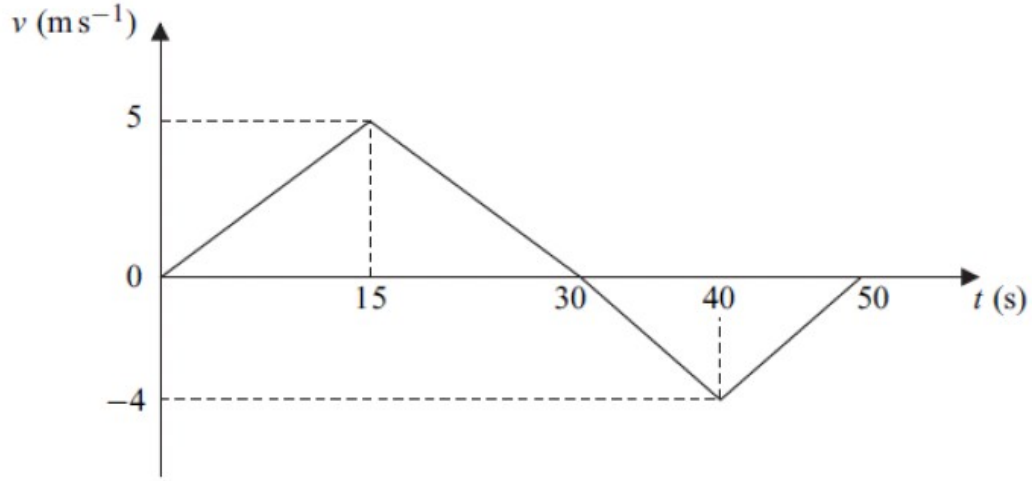
The lift then slows down uniformly, coming to rest after it has been moving for a total of 12 seconds.

(a) Sketch a velocity–time graph for the motion of the lift. *(4 marks)*

(b) Calculate the total distance travelled by the lift. *(2 marks)*

January 2009

2 The graph shows how the velocity of a particle varies during a 50-second period as it moves forwards and then backwards on a straight line.



(a) State the times at which the velocity of the particle is zero. *(2 marks)*

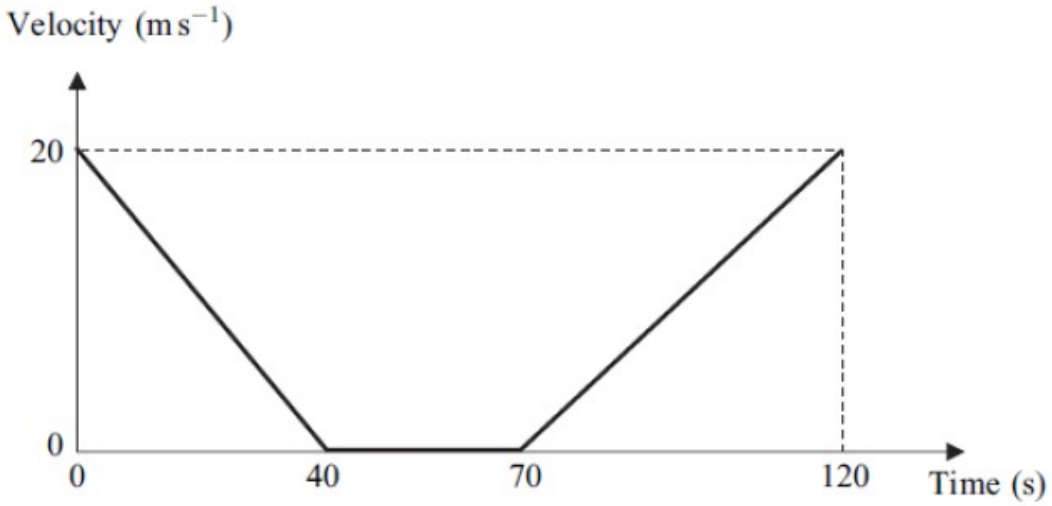
(b) Show that the particle travels a distance of 75 metres during the first 30 seconds of its motion. *(2 marks)*

(c) Find the total distance travelled by the particle during the 50 seconds. *(4 marks)*

(d) Find the distance of the particle from its initial position at the end of the 50-second period. *(2 marks)*

June 2010

1 A bus slows down as it approaches a bus stop. It stops at the bus stop and remains at rest for a short time as the passengers get on. It then accelerates away from the bus stop. The graph shows how the velocity of the bus varies.



Assume that the bus travels in a straight line during the motion described by the graph.

(a) State the length of time for which the bus is at rest. *(1 mark)*

(b) Find the distance travelled by the bus in the first 40 seconds. *(2 marks)*

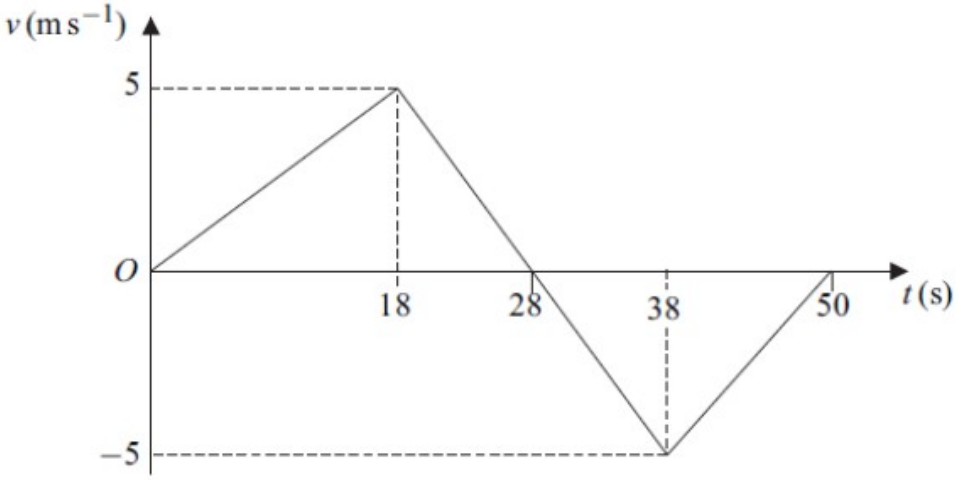
(c) Find the total distance travelled by the bus in the 120-second period. *(2 marks)*

(d) Find the average speed of the bus in the 120-second period. *(2 marks)*

(e) If the bus had not stopped but had travelled at a constant 20 m s^{-1} for the 120-second period, how much further would it have travelled? *(2 marks)*

January 2012

3 The diagram shows a velocity–time graph for a train as it moves on a straight horizontal track for 50 seconds.



(a) Find the distance that the train moves in the first 28 seconds. *(2 marks)*

(b) Calculate the total distance moved by the train during the 50 seconds. *(3 marks)*

(c) Hence calculate the average speed of the train. *(2 marks)*

(d) Find the displacement of the train from its initial position when it has been moving for 50 seconds. *(1 mark)*

(e) Hence calculate the average velocity of the train. *(2 marks)*

(f) Find the acceleration of the train in the first 18 seconds of its motion. *(1 mark)*

AQA Topic Test Question

3 A cyclist accelerates uniformly from rest to a speed of 10 ms^{-1} in 5 seconds. The cyclist then maintains this speed for a further 12 seconds.

3 (a) (i) Sketch a speed-time graph for the motion of the cyclist.

[1 mark]

3 (a) (ii) Use your graph from **(a)(i)** to work out the acceleration of the cyclist in the first 5 seconds.

[1 marks

3 (a) (iii) Use your graph from **(a)(i)** to work out the total distance travelled by the cyclist.

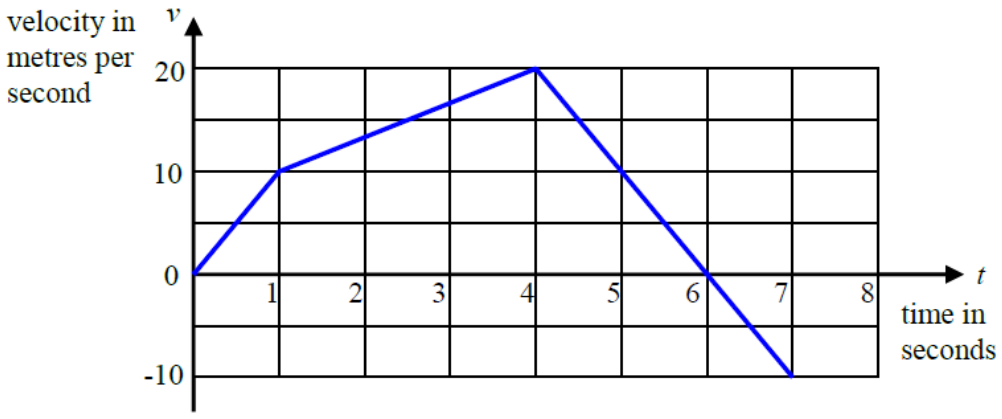
[1 marks]

3 (b) Sketch a distance-time graph for the motion of the cyclist.

[2 marks]

Integral Kinematics Topic Assessment Qs

1. A particle travels in a straight line.
The motion is modelled by the *v*-*t* diagram below.



(i) Calculate the acceleration of the particle in the part of the motion from $t = 1$ to $t = 4$. [2]

(ii) Calculate the displacement of the particle from its position when $t = 0$ to its position when $t = 6$. [4]

(iii) Calculate the displacement of the particle from its position when $t = 0$ to its position when $t = 7$. [2]

(iv) Describe the motion of the particle during the interval $4 \leq t \leq 7$. [2]

4. Cars A and B are travelling in the same direction along a straight road. The time t is in seconds.

At $t = 0$, car A is at rest. It accelerates at 3 ms^{-2} for $0 \le t \le 10$ and then travels at a constant speed.

Car B travels at 15 ms^{-1} for $0 \le t \le 30$ and then accelerates at 1 ms^{-2} until it reaches a speed of 25 ms^{-1}, after which it continues at this constant speed.

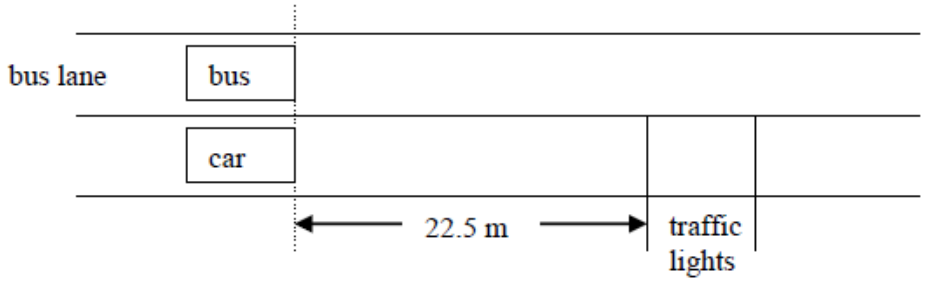
(i) Draw v-t diagrams for the motion of car A and of car B, where v is the speed in ms^{-1} and $0 \le t \le 80$. [4]

(ii) Show that, in the first 40 seconds, car A travels 400 m further than car B. [4]

(iii) Given that car A is 500 m behind car B at $t = 0$, at what value of t does car A catch up with car B? [2]

6. (a) A particle travelling in a straight line at 15 ms^{-1} is brought to rest with constant deceleration in a distance of 22.5 m. Show that the deceleration takes 3 seconds. [2]

(b) A car and a bus are travelling along a straight road towards traffic lights (see diagram below).



The traffic lights change at time $t = 0$, where t is in seconds. At this instant the car has a speed of 15 ms^{-1}. The car then

- decelerates uniformly to rest in 22.5 m (as in part (a)),
- waits at the traffic lights for 7 seconds,
- accelerates uniformly up to 15 ms^{-1} in 5 seconds,
- travels at 15 ms^{-1} down the road.

(i) Sketch a v-t diagram for the motion of the car in the interval $0 \le t \le 20$.
Calculate the distance travelled by the car in the interval $0 \le t \le 15$. [6]

When $t = 0$ the car is level with a bus which is travelling at a constant speed of 20 ms^{-1} along a bus lane. The bus is not required to stop at the traffic lights and continues at this speed down the road.

(ii) Show that the bus has travelled 240 m further than the car at the time that the car again reaches 15 ms^{-1}. [2]

Challenge Question

5 A car is initially at rest. On a short journey the car

I. accelerates uniformly for T seconds to a speed of $20\ \text{ms}^{-1}$,
II. then travels at this speed for a period of time,
III. then decelerates uniformly for $2T$ seconds before coming to rest.

(a) In one journey the car moves for a total of 40 seconds and travels a total of 620 m. Using this information:

sketch a velocity-time graph and hence, or otherwise, find T; *(5 marks)*

(b) In the case when $T = 5$, find the time that it would take the car to complete a 1000 m journey. *(3 marks)*